DEFINING POTENTIAL ADOPTERS IN A GRAIN ELECTRONIC MARKETING SYSTEM

By

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NOMENCLATURE

Attitude Variables

NEED — Respondents perceived need for a grain electronic market. A 1 to 5 response is used for the elevator management sample and the mailed producer questionnaire (where 1 = no need, 2 = less than moderate need, 3 = moderate need, 4 = greater than moderate need, and 5 = great need). A 1 to 99 response scale is used for the producer interviews (where 1 implies no need and 99 implies great need).

PCIS — Respondents extent of agreement with the statement that they would use a computerized information system. A 1 to 5 response is used for the elevator management sample and the mailed producer questionnaire (where 1 = strongly disagree, 2 = disagree, 3 = no opinion, 4 = agree, and 5 = strongly agree). A 1 to 99 response scale is used for the producer interviews (where 1 implies strongly disagree and 99 implies strongly agree).

PCTS — Respondents extent of agreement with the statement that they would use a computerized trading system. A 1 to 5 response is used for the elevator management sample and the mailed producer questionnaire (where 1 = strongly disagree, 2 = disagree, 3 = no opinion, 4 = agree, and 5 = strongly agree). A 1 to 99 response scale is used for the producer interviews (where 1 implies strongly disagree and 99 implies strongly agree).

Elevator Management

BGF — Number of producers the managers bought grain from (actual number).

BH — Bushels handled (bushels).

CAP — Storage capacity (bushels).

DM — Delivery method associated with utilizing a contract specifying price and date while allowing for premiums and discounts (percent).

EPA Number of elevators within grain procurement area (actual number).

GDH Percent of grain delivered during harvest (percent).

GPA Grain procurement area (miles).

MI Lack of competing buyers as a perceived cause of market inefficiency (1 to 5 response, where 1 implies no importance and 5 implies great importance).

OBJ Maintaining a high turnover as an operational objective (1 to 5 response, where 1 implies no importance and 5 implies great importance).

SGF Number of producers the managers stored grain for (actual number).

SM Selling method associated with immediate shipment (percent).

TO Type of organization (where 1 represents a cooperative and 2 represents an independent).

Grain Producers

AGE Age of the producer (years).

CIS Utilization of computerized information services (1 to 99 response, where 1 implies no importance and 99 implies great importance).

COMP Ownership of a computer (where 1 implies yes and 0 implies no).

DIVI Percentage of gross farm income derived from the sale of grain (percent).

DIVII Livestock ownership (where 1 implies yes and 0 implies no).

ED Educational level (years).

FM Utilization of the futures market (where 1 implies yes and 0 implies no).

LCB Lack of competing buyers as a perceived cause of market inefficiency (1 to 99 response, where 1 implies no importance and 99 implies great importance).

PCOMP Plans to purchase a computer (where 1 implies yes and 0 implies no).

SIZE	Acres operated (acres).
STOR	On-farm grain storage capacity (bushels).

CHAPTER I

INTRODUCTION

Marketing problems continue to plague the agricultural sector. Problems of market access, lack of buyer competition, inadequate market information, and price fluctuations are constantly resulting in structural changes in the agricultural sector (Rhodes and Forker). Changes in farm size and specialization of farm resources are the most prominent changes apparent today. Larger size and specialization may permit producers to spend more time on marketing. Several alternatives are available to market participants to help combat marketing problems. Some of these options involve specific proposals dealing with only a few commodities, while others attempt to make drastic structural changes. Still another group of proposals attempt to make a non-competitive segment more competitive. This is the main objective of an electronic market.

Electronic Marketing: An Overview

Definition and History

Electronic marketing involves the use of telecommunications and data processing to bring buyers, sellers, and the product together electronically rather than physically. Russell (1981) defines electronic marketing as a market whose trading arena is some electronic medium. The medium used may be a computerized system,

teletype, conference telephones, etc. The primary objective of electronic marketing is to create a centralized trading arena where large numbers of buyers can compete for the product and finalize the sale. Electronic marketing provides a potential means of improving pricing and technical efficiency (Russell, 1981). The reason for changing from a non-electronic market to an electronic market stems from the need to reduce marketing and/or procurement costs as well as to improve pricing performance (Purcell, 1983).

Purcell (1983) looks at electronic marketing in a what, why, and how perspective providing specific focus on some of the basic issues involved in electronic marketing. In his definition of electronic marketing, Purcell leaves the concept broad enough to apply to all products rather than just agricultural commodities. To provide an answer to the "why", Purcell focuses on pressures emerging on the traditional system and how moves to electronic marketing might improve the situation. Purcell emphasizes in the "how" phase that individuals and institutions expected to participate should be actively involved in the planning phase. Purcell also emphasizes the importance of education and credibility.

Russell and Purcell (1979) investigated the marketing of slaughter cattle through some electronic medium in an effort to increase the effectiveness and efficiency of a proposed Virginia Electronic Marketing System. The results identify certain characteristics which an electronic marketing system should and should not possess. Progressive bidding should be used by the new electronic marketing system instead of regressive bidding. Third parties should be involved in the grading process while a marketing organization should be formed to settle disputes between market participants.

The concept of electronic marketing in the non-grain areas is not new. Bell and Henderson (1983) describes the history of electronic marketing. Ontario Canada was the originating point for the first teletype auction in 1961, when the Ontario Pork Producers marketing Board began marketing slaughter hogs through this electronic medium. The first electronic market in the United States was in Virginia when the conference telephone was used to sell slaughter hogs in 1962. Computer applications of electronic marketing began taking form in 1975 when the Plains Cotton Cooperative Association of Lubbock, Texas began selling cotton through a network of computer terminals that linked sellers and buyers. Video communications also began in Oregon during 1975 and involved the sale of cattle. Video marketing involves making video tapes of the cattle while on the ranches, showing the tapes to assembled buyers, and having an auctioneer conduct an auction.

Functions of Electronic Marketing

Electronic marketing systems, regardless of the type of telecommunications used must be able to (Bell and Henderson, 1983):

1. describe the product,
2. identify the traders,
3. negotiate the sale, and
4. transfer the product.

Description of the product is a crucial requirement for electronic marketing since buyers are typically unable to examine the product and must rely on the product's description. Since market participants are not assembled in one location, the electronic system must provide a

means of identifying and certifying all potential traders. A mechanism must also be provided that facilitates sales negotiations between buyer and seller. Sellers must know when and how to offer the product for sale, and buyers must know about the product and when to bid. Finally, the electronic system must provide for transportation, title transfer, payment, and other functions necessary to transfer the product.

Problem Statement and Objectives

While applications of electronic marketing in the livestock and cotton industries have become common practice, very little is known about the potential application of electronic marketing for grains. One might hypothesize that uniformity in grain quality and standards may enhance the feasibility of electronic marketing for grain.

In order for electronic marketing to be feasible, a diffusion process must take place in the social structure. Diffusion is the process by which an innovation is communicated through channels over time among members of a social system (Rogers, 1962). Rogers (1962) suggests that new innovations are diffused through the market in systematic stages. At the interest stage, the potential user becomes interested enough to find more information on the product (Downey, 1981).

Within the group of potential users, it can be hypothesized that a subgroup exists that is most interested in electronic marketing and represent potential adopters. It is considered important for commercial application of grain electronic marketing to determine the factors that are related to being receptive to a grain electronic

marketing system. More specifically, the physical and personal characteristics as well as the attitude of this group need to be identified.

Objectives

The primary objective is to determine the characteristics associated with the subgroup that has a receptive attitude toward electronic grain marketing. The general hypothesis is that physical and personal characteristics of grain producers and elevator management are related to interest in electronic grain marketing. Factors hypothesized to influence attitudes toward grain electronic marketing are analyzed. From this analysis, characteristics of potential adopters are identified. The specific objectives of this thesis are:

1. to determine attitude of grain producers and elevator management toward electronic grain marketing, and
2. to identify characteristics of grain producers and elevator managers that have interest in grain electronic marketing.

An accurate description of the factors related to interest in grain electronic marketing are crucial to a commercial firm developing an electronic marketing system. The firm could direct their marketing strategies toward this group and design a system which addresses problems within the current system which are identified by the receptive group.

Organization of Thesis

The three objectives of Chapter II are:

1. to describe the data used in the analysis,
2. to identify and summarize the variables used to measure attitudes, and
3. to state the specific hypothesis for each sample.

In Chapter III, the results of the tests for the specific hypotheses generated in Chapter II are presented. In Chapter IV, the results of the hypotheses tests are summarized and the potential adopters associated with each sample are described.

CHAPTER II

DATA AND SPECIFIC HYPOTHESES

Data

Elevator Management

To determine elevator managements' attitude toward electronic marketing, questionnaires were sent to state Grain and Feed Association Officers and Directors west of the Mississippi River. A random sample of federally inspected warehouse managers were also surveyed by mail in most of the states west of the Mississippi River.

The Officers' and Directors' questionnaire represents a longer version of the warehouse management questionnaire; more questions were asked about grain sales, grain deliveries, and the importance of various objectives for their grain handling operation. Similar questions are asked in both questionnaires about operational characteristics, familiarity with electronic marketing, and attitudes toward a grain electronic market.

Questionnaires were sent to 225 Officers and Directors of state Grain and Feed Associations, and 62 responded. Of the 612 questionnaires sent to federally inspected warehouse managers in major grain producing states west of the Mississippi River, 118 responded (Table I).

TABLE I

ELEVATOR MANAGEMENTS' RESPONSE RATE

	Feed and Grain Asso. Officers & Directors	Federally Inspected Warehouse Managers
Number of Questionnaires	225	612
Total Responses	62	118
Response Rate	27%	19%

Grain Producers

Personal interviews were conducted with 150 producers in selected counties of Oklahoma, Kansas, Nebraska, Iowa, Missouri, and Arkansas. A four mile square area was randomly selected from each of the top two grain producing counties within these states. Shorter questionnaires were mailed to grain producers in states west of the Mississippi River. In the personal interviews, more questions were asked about marketing practices and the importance of market characteristics.

The main objective of the mailed producer questionnaire is to provide a broader sample. A total of 1200 questionnaires were distributed to randomly selected corn and soybean producers in Arkansas, Iowa, Kansas, Minnesota, Nebraska, Oklahoma, Texas, South Dakota, North Dakota, and Louisiana. A total of 144 producers responded to the questionnaire (Table II). The larger response rate in the elevator management sample is due to a follow up mailing. No follow up mailing was used in the grain producer sample.

TABLE II

GRAIN PRODUCERS' RESPONSE RATE

	Personal Interviews	Mailed Questionnaires
Total number of questionnaires	150	1200
Total number of respondents	150	144
Response Rate	100%	12%

Variables Used to Define Attitude Toward A Grain Electronic Market

For each sample, three similar questions are used to define attitudes of the respondent toward grain electronic marketing (see Table III). The response scale for these variables is a five point scale in all the samples except the personal producer interviews where a 1 to 99 scale response is used. For the chi-square analysis, the 1 to 99 scale is reduced to a 1 to 5 scale, where:

1 to 20 = 1 (No Need)

21 to 40 = 2

41 to 60 = 3

61 to 80 = 4

81 to 99 = 5 (Great Need)

TABLE III

VARIABLES USED TO DEFINE INTEREST IN GRAIN ELECTRONIC MARKETING

Variable Name	Description	Measurement[1]
NEED	Respondents' perceived need for an electronic market for grains	1 to 5
PCTS	Respondents extent of agreement with statement that they would personally use a computerized system	1 to 5
PCIS	Respondents extent of agreement with the statement that they would personally use a computerized information system	1 to 5

[1] Where 1 equals no need or strongly disagree to 5 which equals great need or strongly agree, respectively.

Attitudes Toward GEM

Descriptive statistics are used to summarize the variables presented in Table III.

Elevator Management. Table IV provides a summary of elevator managements' interest in grain electronic marketing. Overall, the warehouse managers are more receptive to the concept of a grain electronic market than the officers and directors. For example, 21.6 percent of the officers and directors felt they would use a computerized trading system, while 34.2 percent of the warehouse managers felt they would use this type of system. The officers and

directors and warehouse managers are interested in using a computerized information system.

TABLE IV

ELEVATOR MANAGERS' INTEREST IN GRAIN ELECTRONIC MARKETING

Attitude Variable[1]	Feed and Grain Asso. Officers & Directors		Federally Inspected Warehouse Managers	
	Mean	U T[2]	Mean	U T[2]
NEED	2.38	10.9	2.90	23.9
PCTS	2.74	21.6	3.06	34.2
PCIS	3.54	63.5	3.76	72.1

1 Questions 30a, 31f, and 31g of the officers and directors questionnaire and questions 22a, 23f, and 23j of the warehouse managers questionnaire. For a complete description of each variable see Table III.

2 Where (UT) represents the percent responding in the upper tail or a 4 or 5 response on a scale of 1 to 5.

Grain Producers. Table V summarizes the responsiveness of the grain producers toward a grain electronic market. While the personal interview and mailed questionnaire respondents expressed a need for grain electronic marketing, they became less positive with respect to personally using a computerized trading system. The personal interviews and the mailed questionnaire respondents are more receptive toward the idea of personally using a computerized information system.

TABLE V

GRAIN PRODUCERS' INTEREST IN GRAIN ELECTRONIC MARKETING

Attitude Variable[1]	Personal Interviews		Mailed Questionnaires	
	Mean	U T[2]	Mean	U T[2]
NEED	62.5	49.7	3.1	33.3
PCTS	59.1	39.3	3.0	24.0
PCIS	59.3	52.4	3.4	45.2

1 The variables listed in the table are from Part IV, questions 11, 12d, and 12f of the producer personal interviews and Part II, questions 10, 11d, and 11f of the producer mailed questionnaire. For a complete description of each variable see Table III.

2 Where (UT) represents the percentage of respondents in the upper tail. For the personal interviews the upper tail represents a 61 to 99 response on a total 1 to 99 scale. For the mailed questionnaire the upper tail represents a 4 to 5 response on a 1 to 5 scale.

Grain producers expressed a greater need for a grain electronic market (NEED) than the elevator managers. The elevator managers are more positive toward using a computerized information system than the grain producers. The interviewed producers expressed a greater need for grain electronic marketing (NEED) and interest in using a computerized trading system (PCTS).

Factors Hypothesized to Influence Attitude Toward GEM

The factors or characteristics hypothesized to influence attitude are discussed in this section. The same factors are used to define

the operational characteristics of the two elevator samples. Similar characteristics are used to define the operational characteristics of the grain producer samples. Different factors are used in the officers and directors and the personal producer interviews sample that reflect the additional information obtained from the longer questionnaires.

Previous Research

Little previous research on attitude toward electronic marketing has been done. Turner (1983) has studied the issues and provides a potential source of hypotheses for this paper. Turner analyzes factors hypothesized to effect producers' attitude toward a multi-commodity electronic market. Turner's sample was derived from a survey of southwest Georgia producers taken in the summer of 1980. Producers were selected randomly from county Agricultural Soil and Conservation Service files. Two models were estimated. The first model represented the producers initial reaction (positive or negative) to electronic marketing. The second model included additional producers who switched to a positive response after given further information about electronic marketing.

Turner states attitude as an index which is a function of certain producer attributes. The probit procedure was used to identify factors influencing producer attitudes toward electronic marketing. Overall, the Turner study found that initial adopters of electronic marketing would be characterized by optimism and an inclination toward risk. The more diversified operators were more likely to exhibit positive reactions to electronic marketing system.

Elevator Management Hypotheses

Table VI summarizes the factors hypothesized to influence attitude in the elevator manager sample.

The expected impact of the respondents' type of organization (TO) could be considered as ambiguous. A logical argument could be made for either a positive or negative relationship.

A majority of the officers and directors and warehouse managers (64 percent) and (58 percent), respectively, represented independent types of organizations.

Other operational characteristic means and standard deviations are shown in Table VII.

The operational factors in Table VII indicate size of operation and flexibility in making a marketing decision. The direction of impact these factors have on attitude toward grain electronic marketing could be positive or negative. For example, larger size operations will have a greater need to access more buyers and sellers. Large operations could also spread the initial cost of a grain electronic marketing system over a larger volume of grain. Smaller operations, however, are required to make quicker marketing decisions. Searching for buyers and sellers may also be more difficult for the small operation. Therefore, a grain electronic market could benefit small and large operations.

The officers and directors were asked additional questions about actual and preferred methods of sales and delivery. In addition, officers and directors were asked to rank the importance of various objectives in their grain handling operation. When selling grain for

TABLE VI

FACTORS HYPOTHESIZED TO INFLUENCE ELEVATOR MANAGEMENTS' ATTITUDE TOWARD GEM

Factor[1]	Description	Measurement
TO	Type of organization	1-cooperative 2-independent
CAP	Storage capacity	Bushels
GDH	Grain delivered during 1982 harvest	Bushels
GPA	Grain procurement area	Miles
EPA	Number of elevators within procurement area	Number
BGF	Number of producers elevator bought grain from	Number
SGF	Number of producers elevator stored grain for	Number
BH	Bushels of grain handled in 1982	Bushels
SM	Selling method; sold grain for immediate shipment	Percent
MI	Not enough competition among buyers as a perceived cause of market inefficiency	1 to 5[2]
OBJ	Maintaining a high turnover as an objective in grain handling operation	1 to 5[2]
DM	Delivery method; contract specifying price and date but allowed for premiums or discounts if delivered before or after date	Percent

1 The variables listed in this table are from questions 1a, 1c, 4, 5, 6, 7, 8, 9, 10a, 12b, 13b, 17b, and 18e of the officers and directors questionnaire and questions 1b, 1c, 4, 5, 6a, 7, 8, 9, and 10 of the warehouse managers questionnaire.

2 Where 1 equals not important to 5 which equals highly important.

immediate shipment, the entrepreneur has already found a buyer for the grain, so the need for electronic access to buyers may diminish. This may, however, reflect a desire to move grain more quickly. Therefore, selling grain for immediate shipment (SM) may have a positive or negative impact on attitude toward a grain electronic market.

When utilizing a contract specifying price and time of delivery (which allows for premiums or discounts if delivered before or after the specified delivery date) as a delivery method for grain sales, the entrepreneur has essentially commited the grain to one location at a specific time. The need for electronic access to buyers may also diminish unless the contracts can be entered and executed on the electronic system. A negative relationship is hypothesized to exist between utilizing a contract (DM) and the elevator managements' attitude toward a grain electronic market.

Very little difference exists between the officers and directors actual and preferred methods of sale. A discrepancy can be seen, however, when looking at the actual and preferred methods of delivery associated with utilizing a contract. Specifically, the officers and directors preferred to deliver a higher percentage of their grain by using a contract.

Not enough competition among buyers reflects officer and director attitudes toward the traditional market. If the entrepreneur feels that the current market is not providing a satisfactory level of competition, desire for an electronic market may increase. A positive relationship is hypothesized to exist between lack of buyer competition (MI) and the elevator managements' attitude toward an electronic grain market.

TABLE VII

OPERATIONAL FACTORS OF THE ELEVATOR MANAGEMENT QUESTIONNAIRES

Factor[3]	Feed and Grain Asso. Officers & Directors		Federally Inspected Warehouse Managers	
	Mean	Std. Dev.[1]	Mean	Std. Dev.[1]
CAP[2]	6.2	19.3	1.1	1.2
BH[2]	12.5	61.3	1.7	2.3
GDH	69.1	27.7	65.4	27.6
GPH	45.0	53.3	24.0	32.7
EPA	11.0	21.1	7.0	17.7
BGF	441.0	646.1	187.0	179.4
SGF	324.0	548.3	129.0	164.4

1 Standard deviation.
2 In millions.
3 See Table VI for a complete description of each factor.

Maintaining high turnover as an important objective in the entrepreneurs' grain handling operation indicates a desire to have the ability to move grain as quickly as possible. As elevator manager having this objective could find an electronic market for grain advantageous. A positive relationship is hypothesized to exist between maintaining a high turnover (OBJ) and the elevator managements' attitude toward electronic grain marketing.

The officers and directors gave an average rating of 3.02 to lack of buyer competition as a cause of market inefficiency, with a medium of 3.0. An average response of 3.69 was given to the grain handling objective of maintaining a high turnover, with a medium of 4.0.

Characteristics of the Grain Producers' Questionnaires

Table VIII summarizes the characteristics hypothesized to influence grain producer attitudes.

The characteristics hypothesized to influence attitude toward grain electronic marketing used in both the producer personal interviews and the mailed producer questionnaire are summarized in Table IX.

Total acres operated (SIZE) and on-farm storage capacity (STOR) indicates the grain producers' size of operation and flexibility in making a marketing decision. An ambiguous relationship exists between these factors and attitude toward grain electronic marketing. The larger operation may be more willing to adopt grain electronic market due to the ability to absorb the initial cost associated with such an investment. The larger operation can afford to spend more time and money to secure slightly higher prices because of the greater quantity of output. Smaller operations, however, may have a greater need for electronic access of numerous buyers in order to stay competitive.

The grain producers from the personal interviews operated an average of 1214 acres of land with on-farm storage capacity of 35,404 bushels. The grain producers from the mailed questionnaire had fewer acres in operation (859) but greater average on-farm storage capacity (47,888).

TABLE VIII

FACTORS HYPOTHESIZED TO INFLUENCE GRAIN PRODUCERS' ATTITUDE TOWARD GEM

Factor [1]	Description	Measurement
SIZE	Acres operated in 1982	Acres
STOR	On-farm grain storage capacity	Bushels
COMP	Ownership of computer in farm business	1-yes 0-no
CIS	Importance of computerized information sources	1 to 99[2]
LCB	Lack of competing buyers as a perceived source of marketing inefficiency	1 to 99[2]
FM	Utilization of the futures market to price grain	1-yes 0-no
DIVI	Percentage of gross farm income derived from the sale of grain	Percent
DIVII	Livestock ownership	1-yes 0-no
AGE	Age of the producer	Years
ED	Educational level	Years

1 The factors listed in this table are from Part I: questions 1e, 1f, 3, and 4; Part III questions 2g, 5b, and 7; and Part V questions 1a, 1b, 1c, 2, and 3 of the personal producer interviews and Part I questions 1a, 1b, 1c, and 1d; Part III questions 1a, 1b, 2, and 3 of mailed producer questionnaire.

2 Where (1) implies not important to (99) which implies highly important.

TABLE IX

FACTORS HYPOTHESIZED TO INFLUENCE ATTITUDE SIMILAR IN BOTH PRODUCER QUESTIONNAIRES

Factor[3]	Personal Interviews		Mailed Questionnaires	
	Mean	Std. Dev.[1]	Mean	Std. Dev.[1]
SIZE	1213.00	1242.00	859.00	622.00
STOR[2]	35.40	73.10	47.90	63.80
DIVI	76.00	23.00	74.00	26.00
DIVII	.53	.50	.56	.50
AGE	45.00	14.00	48.00	13.00
ED	13.00	2.30	13.00	2.30

1 Standard deviation.
2 In 1000 bushels.
3 See Table VIII for a complete description of each factor.

Percentage of gross farm income derived from the sale of grain (DIVI) and livestock ownership (DIVII) reflects the diversification of the grain producer in terms of other sources of farm and non-farm income. A grain producer with a high percentage of gross farm income from grain sales and limited livestock ownership may be less likely to feed the grain on the farm and more likely to invest in new grain marketing innovations such as GEM. A positive relationship is hypothesized to exist between percentage of gross farm income derived from the sale of grain (DIVI) and the respondents' attitude toward GEM. In addition, a negative relationship is hypothesized to exist

between livestock ownership by the producer (DIVII) and their attitude toward GEM. Turner used a gross farm income factor in his analysis and found it to be insignificant. Correlation among other factors was cited as the major cause for this insignificance.

Producers from the personal interviews reported an average of 76 percent of their gross farm income derived from the sale of grain while 54 percent of these producers did own livestock. The producers from the mailed questionnaire are very similar with an average of 74 percent of their gross farm income derived from the sale of grain and 55 percent owning livestock in the operation.

Age and educational level (ED) of the grain producers are hypothesized to have different impacts on attitude toward electronic grain marketing. Age plays an important role in investment decisions. Younger grain producers may be more willing to invest in a new innovation which has the potential to improve long run marketing opportunities. A negative impact is hypothesized to exist between age and the producers' attitude toward grain electronic marketing. Education reflects a certain degree of progressiveness possessed by the grain producer. Grain producers with more education may be more likely to adopt a new marketing procedure. Educational level of the grain producer (ED) is hypothesized to be positively related to their attitude toward electronic grain marketing. High positive correlations with education was also reflected in Turner's model.

Grain producers form the personal interviews and mailed questionnaires had an average age of 44 and 48 years, respectively, and the equivalent of one year in college (13 years of education).

Table X provides a summary of the remaining impact variables unique to the personal producer interviews. Ownership of a computer in the farm business (COMP) and plans to purchase a computer (PCOMP) are indications of the progressiveness of the grain producer. The more progressive a producer is the more likely to adopt a new innovation such as grain electronic marketing. Also, ownership of a computer may reduce the marginal cost of adopting electronic marketing both in dollars and time. A positive relationship is hypothesized to exist between these two variables (COMP and PCOMP) and the grain producers' attitude toward GEM. A very small percentage of respondents from the personal producer interviews owned a computer for their farm business. Additionally, few respondents planned to purchase a computer within the next 5 years.

The respondents were asked to rank on a scale of 1 to 99 the importance of lack of competing buyers as a cause of market inefficiency (LCB). Grain producers who view lack of competition as a major factor in market inefficiency are more likely to adopt a new innovation designed to give access to more markets. A positive relationship is hypothesized to exist between the variable LCB and the participants' attitude toward electronic grain marketing.

Utilization of the futures market (FM) by a respondent is a good indication of marketing progressiveness. An individual who has adopted futures markets as a marketing tool is more likely to accept a new marketing innovation such as grain electronic marketing. A positive impact is likely to exist between utilization of the futures market (FM) and the grain producers' attitude toward electronic grain marketing.

TABLE X

FACTORS HYPOTHESIZED TO INFLUENCE ATTITUDE UNIQUE TO THE PERSONAL INTERVIEWS

Factor[2]	Personal Interviews	
	Mean	Std. Dev.[1]
COMP	15%	.21
PCOMP	21%	.33
CIS	31.00	32.00
LCB	64.00	27.00
FM	.32	.47

[1] Standard deviation.
[2] See Table VIII for a complete description of each factor.

Respondents from the personal interviews gave an average rating of 64 to lack of competing buyers as a perceived cause of market inefficiency. About one-third (31 percent) of the respondents used the futures market to price their grain.

CHAPTER III

HYPOTHESIS TESTS (EMPIRICAL RESULTS)

Introduction

The purpose of this chapter is to determine the characteristics of grain producers and elevator management associated with a receptive attitude toward an electronic grain market. This objective is accomplished by using two methods to test hypotheses. First, tests for significant relationships between characteristics and attitude toward GEM are conducted using a chi-square test at an arbitrary level of significance of .15. Second, the simultaneous relationship between respondents' characteristics and their attitude toward GEM are determined using quantal choice and regression models.

The Chi-Square Tests

A chi-square statistic is a nonparametric method which uses relative ranks of observations rather than their actual numerical values. This method is particularly valuable when unable to obtain numerical measurements of some phenomena but are able to rank them in comparison to each other (McClave and Benson, 1979).

There is some concern about the validity of the chi-square test when dealing with small sample sizes. Expected cell frequencies of less than 5 have been traditionally classified as too sparse for a valid chi-square test. Recent literature (Roscoe and Byars, 1971) have shown through empirical analysis that the average expected frequency can go as low as 1 at the .05 level and still obtain a valid chi-square test.

Chi-square statistics are calculated for each cell in the contingency table. The total chi-square represents a summation of the individual cell chi-square statistics. The chi-square statistic can be expressed mathematically as:

$$X2 = \Sigma\left[\frac{(A - E)^2}{E}\right]$$

where

A = actual frequency,

E = expected frequency

$$E = \frac{\text{Row Total X Column Total}}{\text{Total Observations}}$$

Elevator Management. Tables XI and XII summarize the chi-square tests for the officers and directors and the warehouse managers, respectively.

Storage capacity (CAP) influences attitude in the elevator management sample. In the officer and directors questionnaire, storage capacity is related to using a computerized trading (PCTS) and information (PCIS) system. In the warehouse managers questionnaire, storage capacity is related to need to GEM (NEED) and using a computerized trading system (PCTS).

TABLE XI

OFFICERS' AND DIRECTORS' CHARACTERISTICS VS. ATTITUDE TOWARD GEM: CHI-SQUARE TEST

Factor[1]	Attitude Variable[2]					
	NEED		PCTS		PCIS	
	CHI2[3]	OSL[4]	CHI2[3]	OSL[4]	CHI2[3]	OSL[4]
TO	4.16	.2448	2.91	.5727	2.50	.6439
CAP	11.39	.2500	27.15	.0073	18.89	.0911
GDH	4.86	.5619	10.51	.2312	4.07	.8504
BH	2.40	.8792	12.33	.1370	6.54	.5866
GPA	6.37	.3825	6.30	.6131	6.87	.5512
EPA	1.80	.9371	13.22	.1045	11.70	.1650
BGF	5.77	.4489	12.36	.1360	5.00	.7572
SGF	4.48	.6120	8.90	.3504	4.18	.8405
SM	3.22	.7805	6.62	.5784	11.77	.1618
DM	12.11	.0595	9.78	.2811	18.60	.0171
MI	13.36	.0377	4.72	.7875	6.09	.6369
OBJ	5.10	.5299	7.87	.4458	17.83	.0226

1 See Table VI for a complete description of each factor.
2 See Table III for a complete description of each variable.
3 Where (CHI2) represents the chi-square statistic.
4 Where (OSL) represents the observed significance level, which is the probability that the null hypothesis (no relationship) is true.

TABLE XII

WAREHOUSE MANAGERS' CHARACTERISTICS VS. ATTITUDE TOWARD GEM: CHI-SQUARE TEST

	Attitude Variable[2]					
Factor[1]	NEED		PCTS		PCIS	
	CHI2[3]	OSL[4]	CHI2[3]	OSL[4]	CHI2[3]	OSL[4]
TO	3.08	.5432	2.02	.7317	3.29	.5105
CAP	13.72	.0895	16.35	.0377	7.00	.5365
GDH	4.75	.7834	5.37	.7171	7.43	.4910
BH	4.62	.7976	4.28	.8303	5.79	.6701
GPA	12.95	.1135	7.04	.5327	8.85	.3554
EPA	8.40	.3049	6.73	.5662	5.44	.7100
BGF	4.93	.7648	8.20	.4143	2.43	.9648
SGF	5.55	.6978	7.24	.5107	7.41	.4931

1 See Table VI for a complete description of each factor.
2 See Table III for a complete description of each variable.
3 Where (CHI2) represents the chi-square statistic.
4 Where (OSL) represents the observed significance level, the probability that the null hypothesis (no relationship) is true.

Bushels handled by the officers and directors is related to using a computerized trading system (PCTS). The number of elevators within the grain procurement area (EPA) and the number of producers from whom the officers and directors bought grain (BGF) is also related to personally using a computerized trading system (PCTS). Managers who use a contract specifying price and date while allowing for premiums and discounts (DM) is also related to officers and directors perceived

need for a grain electronic market (NEED) and using a computerized information system (PCIS). The importance of maintaining a high turnover as an operational objective (OBJ) of the officers and directors is related to using a computerized information system. The radius of the warehouse managers' grain procurement area (GPA) is related to perceived need for a grain electronic market (NEED).

Grain Producers. Tables XIII and XIV summarize the results of the chi-square test for the personal interviews and the mailed producer questionnaire.

Number of acres operated (SIZE) influences attitude in the grain producer sample. In the personal interviews, SIZE is related to using a computerized trading (PCTS) and information (PCIS) system. In the mailed producer questionnaire, SIZE is related to using a computerized information system (PCIS). On-farm storage capacity (STOR) also influences attitude in the grain producer sample. STOR is related to using a computerized trading system (PCTS) in the personal interviews and using a computerized information system (PCIS) in the mailed questionnaire.

Age in the producer sample is related to attitude. In the personal interviews, AGE is related to using a computerized trading system (PCTS), while AGE is related to NEED, PCTS, and PCIS in the mailed producer questionnaire.

The educational level of the grain producer in both samples i related to attitude toward grain electronic marketing. Education (ED) is related to NEED, PCTS, and PCIS is the personal interviews and PCTS and PCIS in the mailed questionnaire.

TABLE XIII

CHARACTERISTICS OF THE RESPONDENTS FROM THE PERSONAL INTERVIEWS VS. ATTITUDE TOWARD GEM: CHI-SQUARE TEST

	Attitude Variable [1]					
Factor [2]	NEED		PCTS		PCIS	
	CHI2 [3]	OSL [4]	CHI2 [3]	OSL [4]	CHI2 [3]	OSL [4]
SIZE	4.31	.8277	22.07	.0048	13.31	.1017
STOR	7.39	.4954	13.31	.1016	7.13	.5224
COMP	6.79	.1471	14.14	.0069	8.58	.0726
PCOMP	7.99	.4343	23.44	.0028	21.62	.0057
CIS	14.19	.0770	12.58	.1272	11.37	.1816
LCB	20.55	.0084	10.42	.2370	9.37	.3118
FM	3.69	.4495	15.01	.0047	12.98	.0114
AGE	2.03	.9801	23.34	.0030	10.78	.2143
ED	10.40	.0342	20.43	.0004	11.95	.0177
DIVI	11.21	.5114	9.58	.6529	19.53	.0765
DIVII	1.39	.8459	2.54	.6382	1.89	.7546

1 See Table III for a complete description of each variable.
2 See Table VIII for a complete description of each factor.
3 Where (CHI2) represents the chi-square statistic.
4 Where (OSL) represents the observed significance level, the probability that the null hypothesis (no relationship) is true.

TABLE XIV

CHARACTERISTICS OF THE RESPONDENTS FROM THE MAILED QUESTIONNAIRE VS. ATTITUDE TOWARD GEM: CHI-SQUARE TEST

	Attitude Variable[1]					
Factor[2]	NEED		PCTS		PCIS	
	CHI2[3]	OSL[4]	CHI2[3]	OSL[4]	CHI2[3]	OSL[4]
SIZE	8.44	.3913	8.85	.3546	16.19	.0397
STOR	7.53	.4805	13.89	.0846	18.32	.0190
AGE	14.08	.0796	13.89	.0846	18.32	.0190
ED	6.06	.1947	10.16	.0378	8.96	.0620
DIVI	19.19	.0841	10.23	.5950	16.11	.1859
DIVII	9.42	.0514	8.21	.0841	3.94	.4148

1 See Table III for a complete description of each variable.
2 See Table VIII for a complete description of each factor.
3 Where (CHI2) represents the chi-square statistic.
4 Where (OSL) represents the observed significance level, the probability that the null hypothesis (no relationship) is true.

Ownership of livestock by the grain producers (DIVII) in the mailed questionnaire is significantly related to perceived need (NEED) and using a computerized trading system (PCTS). Percentage of gross farm income derived from the sale of grain (DIVI) influences the personal interview respondents' attitude toward personally using a computerized trading system (PCTS).

Computer ownership (COMP) and plans to purchase a computer (PCOMP) influences attitude in the personal interviews. COMP is significantly related to NEED, PCTS, and PCIS, while PCOMP is related

to using a computerized trading (PCTS) and information (PCIS) system. Utilization of computerized information services (CIS) is significantly related to NEED and PCTS, while lack of competing buyers as a perceived cause of market inefficiency is significantly related to NEED. A significant relationship can also be seen with the utilization of the futures market and the respondents attitude or responsiveness toward grain electronic marketing, specifically PCTS and PCIS.

The next section will focus on the development of statistical models in order to determine the simultaneous impact of the respondents' characteristics and their attitude toward GEM.

Statistical Models

Introduction

The objective of this section is to simultaneously evaluate the relationships between characteristics and attitude. This is accomplished through the use of logistic regression and ordinary least squares regression. Logistic regression is used on the warehouse managers questionnaire (in the elevator management sample) and the producer mailed questionnaire (in the grain producer sample). Linear regression models are developed on the transformed standard normal deviates of the 1 to 99 scale used in the producer personal interviews. These models will provide the direction of impact of the factors on attitude. Before presenting the results, an introduction on each procedure is presented.

Linear Regression

Ordinary least squares regression is a traditional procedure for estimating relationships among independent variables on a dependent variable. Given the model;

$$Y = BO + B1X1 + \ldots + BnXn + e$$

ordinary least squares minimizes the sum of error squared. The application of this model rests upon the assumptions that:

1. expected value of the error term (e) is o,
2. the disturbance terms have identical variance,
3. explanatory variables are uncorrelated, and
4. explanatory variables have fixed values in repeated samples.

In order to approximate a psychological curve more accurately, a 1 to 99 scale response is often converted to standard normal deviates (Wolins and Dickinson, 1973). The 1 to 99 response can be directly applied to a normal distribution area. An individual who gave for example a 5 response represents 5 percent of the area under the normal distribution or a -1.64 standard deviates away from the middle. By converting a 1 to 99 scale response to a standard normal deviate variations from the middle (50) become more important. For calculation simplicity, it is common practice to transform the standard normal deviate into a non-negative number.

Quantal Choice Models

Social scientists are concerned in general with the problem of explaining and predicting individual behavior. Sometimes the researcher is faced with situations in which the choice alternatives

are limited in number, that is, the alternatives are discrete or quantal (Judge). Such is the case in the warehouse managers and producer mailed questionnaire, where a 1 to 5 response scale is used. Qualitative data create serious problems in the statistical assumptions of a regression model when OLS is employed. Some of the specific problems are (Judge, 1980):

1. the error term (ei) does not equal zero,
2. heteroscedasticity,
3. inefficient and imprecise estimates,
4. very sensitive to values taken by the explanatory variable,
5. tests of significance do not apply.

Statistical analysis of population choice behavior is complicated by the fact that such behavior must be described in probabilistic terms.

Linear probability models attempt to correct the heteroscedasticity of the data. Inequality-restricted least squares attempts to ensure that the predicted estimate fall within the confidence interval. A group of approached attempt to redefine the probability distribution as a cumulative distribution function (CDF). These approaches are known as transformations and are used to model attitude for the 1 to 5 categorical responses.

Transformation Approach. Attitude of the individual can be stated as an index such that;

$$Ii = Xi\ B$$

where

Ii = attitude index,

Xi = matrix of attributes of the individual, and

B = vector of population parameter.

It is assumed that the larger the value Ii, the greater the probability that a certain event (a negative response) will occur. It can therefore be assumed that a monotonic relationship exists between the attitude index and the particular event. Under this assumption, the true probability function would have the shape of a cummulative distribution function (CDF). The two most widely used cummulative distribution functions are the normal and the logistic, with the associated analysis called probit and logit, respectively. A logistic CDF is used in this analysis because of its close approximation to a normal and its numerical simplicity. The logistic model rests upon the assumption that the error is independently and identically distributed with Weibull density distribution (Judge, 1980).

For each sample (i) a response function is calculated. The response function can be written as:

$$Yij = Xi\ B + ei$$

where

Yij = response,

xi = matrix of characteristics of the individual,

B = vector of parameter, and

ei = random error.

For each individual in the sample, the response function is calculated and estimated for B are obtained which compare a certain category (for example 1) to the last category (which is 5). This comparison between the levels and the last level can be shown by the following relationship:

$$Yi = \ln \frac{P1}{P5}$$

where

P1 = probability of a 1 response,

P5 = probability of a 5 response.

The response function represents the natural logarithm of the fraction of a category and the last category. In terms of the 1 to 5 scale response, levels 1, 2, 3, and 4 are compared to 5.

Estimated Quantal Choice Models

The results of the quantal choice models for the warehouse managers questionnaire and the mailed producer questionnaire are presented in this section. Due to the limited observations in the officers and directors questionnaire as well as missing values, which are apparent in the chi-square test, quantal choice models are not applied to this sample.

The three models developed for the warehouse managers questionnaire as well as the mailed producer questionnaire are associated with the attitude variables and the characteristics hypothesized to influence attitude. The results of these three models are presented in Table XV.

In order to provide a more accurate and direct interpretation of the logistic models, an example is presented. The example represents the average or typical respondent, determined through summary statistics, for the warehouse managers questionnaire. The typical respondent from the warehouse manager questionnaire:

TABLE XV

QUANTAL CHOICE MODELS FOR THE ATTRIBUTES IN THE WAREHOUSE MANAGERS' QUESTIONNAIRE

Factor[2] Level		Attitude Variable[1] NEED		PCTS		PCIS	
		Estimate[3]	OSL[4]	Estimate[3]	OSL[4]	Estimate[3]	OSL[4]
INT	1-5	- .1099540	.7058	16.1394000	.8608	1.4877770	.9935
	2-5	-1.3019000	.1410	6.3147500	.0443	14.9516000	.8900
	3-5	.0229512	.9917	5.9081400	.0417	.6228220	.7317
	4-5	-1.0412600	.6742	5.5375000	.0544	1.3380300	.3829
TO	1-5	2.2737000	.0431	.9736000	.4486	3.5490000	.2007
	2-5	1.3019000	.1410	- .4849000	.6414	-.4365000	.6776
	3-5	1.7279000	.0423	.0219500	.9822	1.1938000	.1141
	4-5	.8486000	.3741	- .6446000	.5170	.2649000	.6682
CAP	1-5	.0000040	.0285	.0000040	.0120	.0000010	.4317
	2-5	.0000020	.3268	.0000010	.3961	-.0000020	.1985
	3-5	.0000030	.0627	.0000020	.0782	-.0000003	.7384
	4-5	.0000030	.0607	.0000020	.1258	-.0000002	.6762
BH	1-5	- .0000010	.0198	- .0000020	.0243	-.0000002	.8894
	2-5	- .0000007	.2199	- .0000006	.2369	.0000009	.3641
	3-5	- .0000010	.0441	- .0000009	.0401	.0000002	.7783
	4-5	- .0000020	.0216	- .0000006	.0662	.0000005	.2048
GDH	1-5	- .0277400	.2022	- .0434940	.0863	-.0169500	.5652
	2-5	- .0074500	.6890	- .0296700	.1942	-.0203900	.3698
	3-5	- .0215300	.2221	- .0289000	.1852	-.0215200	.1198
	4-5	- .0088900	.6491	- .0231700	.2832	-.0065200	.5671
GPA	1-5	- .1713400	.0347	- .1011200	.0595	-.0357700	.6200
	2-5	- .0268900	.2101	- .0240400	.3191	-.0063600	.8275
	3-5	- .0111020	.4359	- .0269800	.2169	-.0545000	.1515
	4-5	- .0005700	.9721	- .0104950	.4762	-.0097510	.4016
EPA	1-5	.0161200	.9425	.1657800	.0672	.0002220	.9986
	2-5	.1378000	.3709	.0740400	.1624	-.0035500	.9482
	3-5	.0236300	.8771	.0633800	.2094	-.1201000	.3393
	4-5	.1086600	.4757	- .0294700	.6622	-.0373800	.1774
BGF	1-5	.0011470	.9081	.0006340	.9514	.0050200	.6485
	2-5	.0028530	.6454	.0039600	.6118	-.0106300	.2131
	3-5	.0009010	.8823	.0054100	.4672	.0034200	.4974
	4-5	- .0036900	.6288	- .0022400	.7638	-.0056900	.1425

TABLE XV Continued

Factor[2] Level		Attitude Variable[1]					
		NEED		PCTS		PCIS	
		Estimate[3]	OSL[4]	Estimate[3]	OSL[4]	Estimate[3]	OSL[4]
SGF	1-5	- .0021700	.8423	- .0057300	.6235	-.0123800	.5361
	2-5	.0017900	.7963	- .0086900	.3881	.0201800	.0286
	3-5	- .0022200	.7429	- .0119700	.1583	.0011040	.8415
	4-5	.0012400	.8818	- .0050600	.5466	.0067700	.1405

1 See Table III for a complete description of each variable.

2 See Table VI for a complete description of each factor.

3 The (Estimate) represents the estimated parameter from the quantal choice model. The model provides an estimate for each level of the response scale. The estimate at any given level is being compared to the probability of a 5 response (positive response).

4 Where (OSL) represents the observed significance level associated with the test on the null hypothesis (no relationship) is true.

5 Where INT represents the intercept.

1. has an independent type of questionnaire,
2. has a storage capacity of 1.1 million bushels,
3. handles 1.7 million bushels of grain,
4. has 65 percent of grain is delivered during 1982 harvest,
5. has a grain procurement area of 24 miles,
6. has 7 other elevators within the grain procurement area;
7. bought grain from 197 producers, and
8. stored grain for 129 producers.

Given the above characteristics of the typical warehouse manager, the response function can be determined. For this example, the 1 to 5 level (a 1 response as opposed to a 5 response) is calculated and interpreted for the attitude variable NEED. By inserting the appropriate characteristics for the typical respondent into the model the response function can be calculated.

$$\text{NEED 1-5} = -1.09954 + 2.2737(\text{YO}) + .000004(\text{CAP}) - .000001(\text{BH}) - .02774(\text{GDH}) - .17134(\text{GPA}) + .01612(\text{EPA}) + .001147(\text{BGF}) - .002170(\text{SGF})$$

$$\text{NEED 1-5} = .279999$$

$$e^{.27999} = 1.3231$$

$$\text{P1/P5} = 1.3231$$

where

P1 = probability of a one response,

P5 = probability of a five response, and

e = the natural log base = 2.71828.

Since P1/P5 is greater than 1, the probability of a one response (negative response) is greater than the probability of a 5 response (positive response). In other words, given the attributes of a typical respondent there is a greater probability for a negative response. In order to understand how each factor affects attitude toward grain electronic marketing, the attributes need to be explained in terms of how they affect the response function.

Type of organization possesses a significant positive parameter estimate in the model associated with NEED at the 1 to 5 level (the observed significance level is less than the pre-determined level of significance of .15). This positive parameter has the potential to increase the response function and in turn increase the probability of a negative response (P1 > P5). A positive parameter on type of organization is exerting a negative impact on attitude toward the variable NEED. The results from the model indicate that the probability of independent type of organization giving a negative response is greater than a cooperative giving a negative response.

Significantly positive parameter estimates can be found in the model associated with storage capacity (CAP). This positive parameter indicates the response function increases as storage capacity increases. A large response function increases the probability of a negative response. The model indicates that storage capacity is exerting a negative influence on attitude and smaller storage facilities would be more receptive toward grain electronic marketing.

Bushels handled by the warehouse managers (BH) possessed a significant negative parameter estimate in the model. As bushels handled by the operation increase the probability of a negative

response decreases. Larger elevators in terms of bushels handled are more receptive toward the concept of a grain electronic market.

At one response level in the model, the characteristic associated with the percentage of grain delivered during the 1982 harvest, possessed a negative parameter estimate. The probability of a negative response decreases as the amount of grain delivered during the 1982 harvest increases. Operations with a large amount of grain being delivered during the harvest months are more receptive toward the concept of a grain electronic market.

The results of the models for the mailed producer questionnaire are presented in Table XVI.

There is a significant negative estimate associated with SIZE and personally using a computerized information system. As the number of acres in operation increase, the probability of a negative response to personally using a computerized information system (PCIS) decreases. Larger sized operations in terms of acres in operation are more receptive toward using a computerized information system (PCIS).

Age of the producer (AGE) seems to play a role in determining attitude toward grain electronic marketing. A positive parameter exists in the model for using a computerized trading (PCTS) and information (PCIS) system which indicates that the probability of a negative response increases as the age of the producer increases. Therefore, it can be concluded from the model that younger producers are more willing to use a computerized trading (PCTS) and information (PCIS) system.

Educational level (ED) of the respondent seems to exert some influence on the model with respect to need for GEM (NEED). A

TABLE XVI

QUANTAL CHOICE MODELS FOR THE ATTRIBUTES IN THE MAILED PRODUCER QUESTIONNAIRE

Factor[2] Level		Attitude Variable[1]					
		NEED		PCTS		PCIS	
		Estimate[3]	OSL[4]	Estimate[3]	OSL[4]	Estimate[3]	OSL[4]
INT	1-5	6.6396100	.2551	-7.6405900	.3779	-11.3289060	.1285
	2-5	7.7017000	.1024	1.5502200	.8033	-2.7940100	.5064
	3-5	8.0284200	.0709	2.8257400	.6311	-1.1285600	.7614
	4-5	9.2980500	.0456	-3.8782200	.5283	-5.8447400	.1302
SIZE	1-5	- .0008400	.5269	- .0016800	.3799	- .0017400	.3479
	2-5	.0000900	.9068	- .0011300	.2431	- .0016900	.1448
	3-5	.0004380	.5139	- .0004200	.5928	- .0005900	.3008
	4-5	- .0000200	.9822	- .0006000	.4761	- .0004200	.4518
STOR	1-5	- .0000040	.7503	- .0000010	.9689	- .0000070	.7608
	2-5	- .0000010	.7895	.0000090	.4794	- .0000004	.9759
	3-5	- .0000100	.0693	.0000020	.8499	- .0000070	.3598
	4-5	- .0000060	.3597	.0000050	.7414	.0000040	.5154
AGE	1-5	.0410300	.3774	- .1641450	.0711	.1775000	.0154
	2-5	- .0152440	.6687	.0845800	.2252	.1265400	.0071
	3-5	- .0113800	.7329	.0601200	.3747	.0738900	.0499
	4-5	- .0313100	.3742	.0598700	.3869	.0626200	.0993
ED	1-5	- .3151000	.1917	- .0067400	.9855	.2174200	.4733
	2-5	- .2908500	.1265	- .2641900	.3557	- .0018300	.9933
	3-5	- .2921300	.0974	- .2539600	.3474	- .0521500	.7609
	4-5	- .3630700	.0526	.0332210	.9044	- .1709500	.3219
DIVI	1-5	- .0504200	.0993	.0091000	.8246	.0040800	.9022
	2-5	- .0307800	.2514	- .0018500	.9551	- .0224300	.3573
	3-5	- .0282600	.2746	.0036200	.9081	.0046910	.8100
	4-5	- .0237600	.3785	.0270600	.4108	.0221120	.2644

TABLE XVI Continued

Factor[2] Level		Attitude Variable[1]					
		NEED		PCTS		PCIS	
		Estimate[3]	OSL[4]	Estimate[3]	OSL[4]	Estimate[3]	OSL[4]
DIVII	1-5	- .0623800	.9641	10.4266000	.9162	- .7271800	.6746
	2-5	.9753700	.3750	11.4923000	.9076	- .5125200	.6863
	3-5	1.4442000	.1720	12.0491000	.9032	1.1699000	.2263
	4-5	1.0676900	.3341	12.2396000	.9017	1.4421700	.1293

1 See Table III for a complete description of each variable.

2 See Table VIII for a complete description of each factor.

3 The (Estimate) represents the estimated parameter from the quantal choice model. The model provides an estimate for each level of the response scale. The estimate at any given level is being compared to the probability of a 5 response (positive response).

4 Where (OSL) represents the observed significance level associated with the test on the null hypothesis (no relationship) is true.

5 Where INT represents the intercept.

negative parameter estimate for this factor indicates that as educational level increases the probability of a negative response decreases. Therefore, the more educated grain producer feels a greater need for a grain electronic market.

The Ordinary Least Squares Regression Models Used in the Producer Personal Interviews

The 1 to 99 scale response used in the producer personal interviews are converted to a standard normal deviate in order to more accurately approximate a psychological curve. Ordinary least squares regression (OLS) is employed to determine the simultaneous relationship of the hypothesized factors on attitude toward GEM. Table XVII summarizes results of the OLS models.

The number of acres in operation seemed to have a positive impact on the model. The results of the model indicate that as acres in operation increase responses toward using a computerized trading (PCTS) and information (PCIS) system become more positive.

A significant negative sign can be seen to exist in the model between on-farm storage capacity (STOR) and need for a grain electronic market (NEED). This indicates that as storage capacity increases the producers' perceived need for a grain electronic market decreases.

While computer ownership of the respondents did not have a significant impact on the attitude models, intentions to purchase a computer did have a significant positive impact on need for grain electronic marketing (NEED), using a computerized trading (PCTS), and

TABLE XVII

ORDINARY LEAST SQUARES REGRESSION MODELS FOR THE ATTRIBUTES IN THE PRODUCER PERSONAL INTERVIEWS

	Attitude Variable[1]					
Factor[2]	NEED		PCTS		PCIS	
	Estimate[3]	OSL[4]	Estimate[3]	OSL[4]	Estimate[3]	OSL[4]
INT	420.275100	.0001	265.905500	.0056	263.201700	.0101
SIZE	.005914	.4914	.030628	.0053	.026509	.0223
STOR	- .000270	.1312	- .000138	.5520	- .000240	.3340
COMP	30.450500	.3651	19.710300	.6416	-12.932000	.7739
PCOMP	44.427300	.0564	73.598100	.0125	86.700000	.0058
CIS	.231480	.3240	.428960	.1477	.538250	.0892
LCB	1.042000	.0003	.715979	.0388	.531003	.1477
FM	14.782500	.3521	6.046740	.7598	- 4.821700	.8210
AGE	- .429040	.3989	-2.238100	.0007	- 1.442600	.0371
ED	-6.938800	.0386	1.015440	.8082	1.214900	.7858
DIVI	- .724469	.0514	- .048660	.9164	.236400	.6332
DIVII	-8.402300	.6187	14.354700	.4997	.702780	.9753
F	2.94	.0024	4.91	.0001	3.20	.0011
R^2	.2642500		.3724000		.281119	

1 See Table III for a complete description of each variable.
2 See Table VIII for a complete description of each factor.
3 The estimate represents the estimated parameter from the ordinary least squares regression model.
4 Where (OSL) represents the observed significance level associated with the null hypothesis (no relationship).
5 Where INT represents the intercept.
6 Where (F) represents the F statistic for the entire model.
7 Where (R^2) represents the multiple correlation coefficient.

information (PCIS) system. Plans for computer ownership (PCOMP) has consistently been a strong factor in determining attitude throughout the analysis. Receptiveness of a grain electronic marketing system will depend largely on the grain producers' current attitude and willingness to adopt a computer as a farming tool.

Similarly, willingness to utilize computerized information services has a positive impact on using a computerized trading (PCTS) and information (PCIS) system. Lack of competing buyers as a perceived cause of market inefficiency exerted a positive influence on need for a grain electronic marketing (NEED), using a computerized trading (PCTS), and information (PCIS) system. This indicates that receptiveness of a grain electronic market will depend strongly on the producers' perceived need to improve the current market.

The age of the producer (AGE) continued to exert a negative impact on attitude toward GEM with respect to NEED, PCTS, and PCIS. The model suggests that as age increases, the potential participant is less receptive toward a grain electronic market.

The educational level of the grain producer (ED) possessed a significantly negative impact on perceived need for GEM (NEED). This result seems to indicate that grain producers' perceived need for GEM diminishes as educational level increases.

A significantly negative impact can be seen in the model between percentage of gross farm income derived from the sale of grain (DIVI) and need for a grain electronic market (NEED). This result indicates that grain producers which are diversified into non-grain activities have a lower perceived need for GEM than those who depend largely on the sale of grain.

The objective of the next chapter is to summarize the characteristics associated with potential adopters in a grain electronic market at the producer and first handler level in the marketing chain.

CHAPTER IV

SUMMARY AND CONCLUSIONS

The objective of the thesis is to determine the characteristics of elevator managers and grain producers that are potential adopters of a grain electronic market. In order to measure attitudes toward grain electronic marketing, data from elevator managers and producers are reported and analyzed. The elevator manager sample consisted of state grain and feed association officers and directors as well as federally inspected warehouse managers located in states west of the Mississippi River. The officers and directors had six times as much storage capacity (on the average) as the warehouse managers.

The grain producers' sample consisted of personal interviews and mailed questionnaires for the states west of the Mississippi River. The personal interview respondents had a greater number of acres in operation while the mailed questionnaire respondents possessed more on-farm grain storage capacity. Very little difference can be seen between the two samples in terms of percentage of gross farm income derived from the sale of grain and livestock ownership. The mean age and educational level for both samples were similar.

Three questions were used as measures of attitude toward grain electronic marketing. These questions reflected the respondents

perceived need for a grain electronic market (NEED), extent of agreement with personally using a computerized trading system (PCTS), and the extent of agreement with personally using a computerized information system (PCIS). The officers and directors are a less receptive group toward the concept of a grain electronic market than are the warehouse managers. Both the officers and directors and the warehouse managers indicated they would use a computerized information system. Both samples were also consistent in a negative response toward perceived need for GEM.

In the grain producer samples, very little difference between the personal interviews and the mailed questionnaires with respect to overall attitude toward grain electronic marketing is evident. As with the elevator management sample, receptiveness toward a computerized information system is greater than the receptiveness toward electronic trading.

Chi-square tests, ordinary least squares, and logistic regression models provide an indication of the characteristics associated with potential adopters toward GEM. Significant characteristics of the chi-square tests and statistical models are identified in Table XVIII for the elevator management sample.

The results of the chi-square tests show that the operational characteristics (CAP, BH, EPA, and BGF) of the officers and directors are significantly related to using a computerized trading system. Therefore, actual trading over an electronic medium by the respondent from this sample will depend largely on these operational characteristics. Utilizing a contract (DM) and lack of competing buyers (MI) are related significantly to need for a grain electronic

marketing (NEED), while maintaining a high turnover is related significantly to using a computerized information system.

TABLE XVIII

SUMMARY OF THE HYPOTHESES TESTS FOR THE ELEVATOR MANAGERS[1]

Factors[2]	Grain and Feed Association Officers and Directors[3]			Federally Inspected Warehouse Managers[4]		
	NEED	PCTS	PCIS	NEED	PCTS	PCIS
TO	/	/	/	-,/	?,/	-,/
CAP	/	*	*	-,*	-,*	?,/
GDH	/	/	/	?,/	+,/	+,/
BH	/	*	/	+,/	+,/	?,/
GPA	/	/	/	+,*	+,/	?,/
EPA	/	*	/	?,/	-,/	?,/
BGF	/	*	/	?,/	?,/	?,/
SGF	/	/	/	?,/	?,/	-,/
SM	/	/	/			
DM	*	/	/			
MI	*	/	/			
OBJ	/	/	*			

1 Significance occurs when the observed significant level (OSL) is less than the pre-determined level of significance of .15 in the chi-square tests and statistical models.

2 See Table VI for a complete description of each factor.

3 Where (*) implies significance and (/) implies no significance for the chi-square tests.

4 The sign (-,+) indicates the factor is significant for the quantal coice model. Where (+) implies a positive impact, (-) implies a negative impact, and (?) implies either a positive or negative impact. Where (*) implies significance and (/) implies no significance for the chi-square tests.

In the warehouse managers' questionnaire, storage capacity (CAP) is significantly related to need for a grain electronic market (NEED) and using a computerized trading system. In addition, storage capacity is exerting a negative impact on response toward need for GEM and using a computerized trading system. This indicates that smaller storage facilities feel a stronger need for a grain electronic market and will most likely participate in a computerized trading system. Grain delivered during harvest (GDH), bushels handled (BH), and grain procurement area (GPA) have a positive impact on response toward using a computerized trading system. Larger operations (in terms of GDH, BH, and GPA) are more willing to adopt a computerized trading system. Table XIX summarizes the significant factors of the grain producers sample.

Most of the factors of the personal interviews are significantly related to using a computerized trading system in the chi-square tests. Education (ED) and computer ownership (COMP) have significant relationships with need for a grain electronic market (NEED), using a computerized trading (PCTS) and information (PCIS) system. The regression models show that producers with large amounts of acres in operation will use a computerized trading and information system. Producers with small storage facilities feel a greater need for grain electronic marketing. Younger producers, who plan to purchase a computer, are more likely to adopt a computerized trading and information system.

TABLE XIX

SUMMARY OF THE HYPOTHESES TESTS FOR THE GRAIN PRODUCERS[1]

Factors[2]	Personal Interviews[3]			Mailed Questionnaire[4]		
	NEED	PCTS	PCIS	NEED	PCTS	PCIS
SIZE	?,/	+,*	+,*	?,/	?,/	+,*
STOR	-,/	?,*	?,/	+,/	?,/	?,*
AGE	?,/	-,*	-,*	?,*	+,*	-,*
ED	-,*	?,*	?,*	+,/	?,*	?,*
DIVI	-,/	?,/	?,*	+,*	?,/	?,/
DIVII	?,/	?,/	?,/	?,*	?,*	-,/
COMP	?,*	?,*	?,*			
PCOMP	+,/	+,*	+,*			
CIS	?,/	+,*	+,/			
LCB	+,*	+,/	+,/			
FM	?,/	?,*	?,*			

1 Significance occurs when the observed significant level (OSL) is less than the pre-determined level of significance of .15 in the chi-square tests and statistical models.

2 See Table VIII for a complete description of each factor.

3 The sign (+,-) indicates the factor is significant for the ordinary least squares regression model. Where (+) implies a positive impact, (-) implies a negative impact, and (?) implies either a positive or negative impact. Where (*) implies significance and (/) implies no significance for the chi-square tests.

4 The sign (-,+) indicates the factor is significant for the quantal coice model. Where (+) implies a positive impact, (-) implies a negative impact, and (?) implies either a positive or negative impact. Where (*) implies significance and (/) implies no significance for the chi-square tests.

In the producer mailed questionnaire, acres in operation (SIZE) and storage capacity (STOR) are significantly related to using a computerized information system (PCIS). Age is related to need for GEM (NEED) and using a computerized trading (PCTS) and information (PCIS) system. The quantal choice models show that producers with large amounts of acres in operation are most likely to adopt a computerized information system, while larger storage facilities feel a greater need for GEM. The more educated producer who derives a large percentage of gross farm income from the sale of grain, feel a greater need for a grain electronic market.

The overall attitude of a grain electronic market will depend on several factors. One factor is an accurate description of the potential adopters among the participants. Market strategies can be directed toward this group to assure a more successful diffusion of the new innovation. In addition, the characteristics of the GEM system need to be identified in order to have an applicable system which meets the needs of the potential users.

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